Cogn Ther Res (2009) 33:235–240
DOI 10.1007/s10608-008-9183-0

ORIGINAL ARTICLE

Feeling Better and Smoking Less: The Relationship Between Trauma Symptoms and Smoking Over Time

Amy W. Helstrom · Margret E. Bell · Suzanne L. Pineles

Published online: 31 January 2008

Abstract Although it is well documented that individuals who have experienced traumatic events smoke cigarettes at significantly higher rates than individuals without exposure to trauma, the longitudinal relationship between smoking and trauma-related symptoms remains unclear. The present study examined this issue among 288 female veterans receiving treatment for trauma-related disorders over a period of up to 3 years. Consistent with previous cross-sectional research, across time points more symptomatology was associated with higher rates of smoking. Longitudinally, decreases in symptoms of negative affect over time were associated with decreases in smoking.

Keywords Smoking · Trauma · PTSD · Veteran · Women

Prior research has demonstrated that exposure to traumatic events and the development of posttraumatic stress disorder (PTSD) are associated with a number of adverse mental and physical health outcomes (e.g., Buckley and Kaloupek 2001; Ouimette et al. 1998). One such outcome is tobacco use. Significantly higher rates of current smoking, ever-smoking, and nicotine dependence have been observed among individuals who have been exposed to trauma but have not necessarily developed PTSD (Hapke et al. 2005). Similarly, among individuals with PTSD, 45–60% are current smokers compared to a smoking rate of 22% in the general population (Beckham 1999; CDC 2001; Parslow and Jorm 2006, Breslau et al. 2003). Individuals with PTSD also tend to smoke cigarettes more heavily than individuals without PTSD (Beckham 1996; Feldner et al. 2007a).

Potentially accounting for these findings, existing research indicates that symptom management may play a prominent role in trauma victims' smoking behavior. In particular, trauma victims' smoking may be strongly driven by a desire to reduce negative affect such as anger, depression, and anxiety (Acierno et al. 1996; Beckham 1999; Feldner et al. 2007b). Although there have been relatively few tests of this hypothesis, a recent study that assessed smoking motives among individuals who had been exposed to at least one traumatic event found that higher levels of trauma-related symptoms were associated with a greater likelihood of smoking to reduce negative affect (Feldner et al. 2007b). Beyond the role that affect management might play, it has been suggested that cognitive expectancies may also contribute to the increased smoking in individuals with trauma-related symptomatology. Individuals with greater anxiety sensitivity, such as many individuals who experience trauma symptomatology (McNally 1989), may be more likely to expect nicotine to alleviate anxiety than those without such sensitivity (Zvolensky et al. 2004).

A. W. Helstrom (✉)
VA Boston Healthcare System, 150 South Huntington Avenue (116B), Boston, MA 02130, USA
e-mail: amy.helstrom@va.gov

A. W. Helstrom · S. L. Pineles
Department of Psychiatry, Boston University School of Medicine, Boston, MA, USA

M. E. Bell
Department of Veterans Affairs, Military Sexual Trauma Support Team, Office of Mental Health Services, Boston, MA, USA

M. E. Bell · S. L. Pineles
Women's Health Sciences Division, National Center for PTSD, VA Boston Healthcare System, Boston, MA, USA

Although the relationship between smoking and trauma-related symptoms, particularly negative affect, has been well-established using cross-sectional methodologies (Koenen et al. 2005; Ouimette et al. 2007), and the relationship between trauma exposure and the development of nicotine dependence has been examined in several key studies (e.g., Breslau et al. 2003), to our knowledge, no studies exist examining the relationship between trauma-related symptoms and smoking over time at multiple timepoints (i.e., examining the pattern of relationship over time). To fill this gap, the current study reports on longitudinal data from female veterans enrolled in treatment through a trauma clinic. Given findings reviewed earlier, we hypothesized that longitudinal decreases in trauma-related negative affect over time would be associated with concurrent decreases in smoking. In addition, we hypothesized that other trauma-specific symptoms (e.g., instrusions and problems with self-reference) would be related to smoking behavior such that decreases in these symptoms would be related to decreases in smoking over time.

Method

Participants were 288 female veterans involved in treatment through a women's trauma clinic located in a large urban VA hospital. All participants reported having experienced at least one event that, in the determination of the intake clinician, met criteria outlined in DSM-IV (APA 2000) for a traumatic stressor. Veterans enrolled in this clinic receive individual therapy, group therapy, and/or medication management for trauma-related disorders. The therapy provided is individualized based on the needs and goals of each patient and so may focus on present-centered issues and/or emphasize trauma processing. Both manualized and unstructured treatments are utilized.

As part of their involvement in the clinic, participants were asked to complete a series of measures at intake[1] and approximately every 5 months thereafter for the purpose of program evaluation.[2] Between one ($n = 288$) and nine ($n = 1$) consecutive waves of data were available for analysis in this study, depending upon how long a given participant had been in treatment. (See Table 1 for more details). Although questionnaire packets included a battery of self-report measures and demographic and health behavior questions, in this study, we present only data from demographic items related to smoking and the Trauma Symptom Inventory (TSI; Briere 1995).

[1] Fifty-seven participants were already enrolled in the clinic when the program evaluation was first implemented; their Time 1 data were thus not collected at the time of their intake into the clinic.

[2] These data were subsequently approved for research by the Institutional Review Board.

Measures

The Trauma Symptom Inventory (TSI; Briere 1995), a 100-item self-report measure, was used to assess trauma-related symptomatology in the previous 6 months. Participants' responses to individual items were used to calculate the three factor scores previously identified by confirmatory factor analysis (Briere 1995). The first factor, Dysphoria, draws on items reflecting negative affect such as anger/irritability, depression, and anxious arousal. The Trauma factor summarizes symptoms such as intrusive experiences, defensive avoidance, dissociation, and impaired self-reference. Finally, the Self factor indexes impaired self-reference, sexual concerns, dysfunctional sexual behavior, tension reduction behavior, and anger/irritability.

Smoking was assessed by a single question asking participants whether they currently smoked cigarettes and if so, how much they smoked on a daily basis. Participants responded using a five point ordinal scale (0 = no smoking; 1 = less than ½ pack per day; 2 = between ½ pack and 1 pack per day; 3 = 1 pack per day; and 4 = more than 1 pack per day).

Data Analysis

Data analyses were conducted using hierarchical linear modeling (HLM) with a constant exposure Poisson sampling model and log link function. This procedure allows estimation of both within-person change (through a "level 1" model) and between-person differences in change ("level 2" model) while taking into account the ordinal nature of the smoking outcome variable and the intercorrelations between a participant's scores at different time points (Singer and Willett 2003). Multilevel modeling also permits the use of unbalanced data, thus allowing for situations such as ours where participants varied in the number of data waves available.

After estimating models to establish the baseline variability associated with smoking outcome and each predictor, three analyses (one for each TSI factor score) of primary interest were conducted. Each analysis included Time (modeled as random), the given predictor (modeled as fixed), and the interaction between the predictor and Time (modeled as fixed) on level 1. This interaction addressed the central issue of this paper in that it examined how the relationship between smoking and the predictor might vary over time. Because within-individual change over time was the primary focus, no level 2 variables were included in these models. Missing data on level 1 was handled with list-wise deletion (Raudenbush et al. 2004) at the time of analysis, based on variables included in the model being run.

Table 1 Frequency of smoking and mean TSI among participants across time points (SDs in parentheses)

	Smoking (%)	TSI Trauma	TSI Self	TSI Dysphoria
Time 1 ($n = 288$)	39.2	61.88 (11.63)	57.25 (11.06)	60.23 (10.59)
Time 2 ($n = 97$)	32.0	62.54 (11.23)	56.83 (10.12)	60.74 (10.78)
Time 3 ($n = 53$)	32.1	62.29 (12.25)	56.82 (13.47)	60.04 (11.71)
Time 4 ($n = 34$)	41.2	59.30 (11.39)	54.10 (10.66)	56.59 (10.78)
Time 5 ($n = 25$)	28.0	62.29 (11.51)	54.67 (9.37)	59.44 (11.08)
Time 6 ($n = 13$)	23.1	62.00 (11.34)	54.85 (8.90)	59.54 (11.54)
Time 7 ($n = 8$)	22.2	60.00 (8.73)	54.29 (6.65)	58.25 (9.19)
Time 8 ($n = 4$)	20	61.00 (13.59)	54.00 (8.83)	59.75 (16.07)
Time 9 ($n = 1$)	0	63	53	62

Results

Characteristics of the Sample

Participants ranged from 20 to 84 years old ($M = 44.6$) and self-identified as predominately Caucasian/White (71.2%). Most participants were currently single (42.3%, including 32.6% who were separated or divorced) and approximately half (47%) were parents. Forty-two percent were employed full- or part-time. All women in the sample reported trauma-related difficulties including depression, substance use, emotional dysregulation, and/or re-experiencing symptoms. Medical records indicate that approximately 60% of women in the sample have been given a diagnosis of PTSD by their assessing or treating mental health clinician (E. Davison, personal correspondence, 2007).

At Time 1, 39.2% ($n = 113$) of the sample were smokers. Among smokers, the number of cigarettes smoked per day was fairly evenly distributed: approximately 30% smoked 10 cigarettes or fewer daily, 41% smoked 10–20 cigarettes daily, 18% smoked 20 cigarettes daily, and 11% smoked more than one pack daily. Rates of smoking and mean TSI scores at each time point are reported in Table 1.

The Effect of Time

Unconditional growth models (i.e., those with only Time entered as a predictor) indicated that on average, participants' smoking and Dysphoria, Self, and Trauma factor scores decreased over time.

Table 2 Hierarchical linear modeling results

Model	Smoking		
	B(SE)	*t*	df
Time only			
Intercept	−8 (.11)	−1.71	287
Time	−30 (.06)	−4.79***	287
Dysphoria Factor			
Intercept	−1.92 (.68)	−2.84***	265
Time	.30 (.29)	1.03	265
Dysphoria	.03 (.01)	2.64***	471
Dysphoria × Time	−01 (.005)	−1.96**	471
Trauma Factor			
Intercept	−1.44 (.74)	−1.95**	265
Time	.05 (.27)	0.15	265
Trauma	.02 (.01)	1.83*	471
Trauma × Time	−005 (.006)	−0.97	471
Self Factor			
Intercept	−.81 (.70)	−1.17	264
Time	−.10 (.37)	−0.27	264
Self	.01 (.01)	0.96	463
Self × Time	−.003 (.007)	−0.50	463

Note: Cell values = coefficient in ln units (SE)

* $P < .10$; ** $P < .05$; *** $P < .01$

The Relationship Between Dysphoria, Trauma, and Self Factor Scores and Smoking

The main effect of Dysphoria was significant, indicating that after collapsing across time points, higher Dysphoria

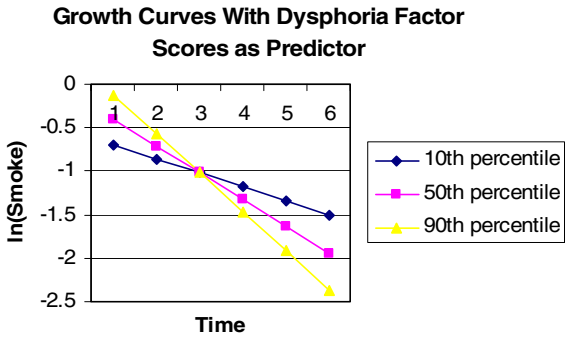

Fig. 1 Dysphoria factor scores as a predictor of smoking behavior over time

(negative affect) factor scores were associated with significantly higher rates of smoking (Table 2). This effect was small in size ($Pr = .12$). The effect for the interaction between Time and Dysphoria was also significant but small ($Pr = .09$), with smoking decreasing much more quickly among women with higher negative affect scores over time than among women with lower negative affect scores over time (see Fig. 1). Among women with fluctuating negative affect over time, increases in symptomatology were associated with increases in smoking; decreases in symptomatology were associated with decreases in smoking.

There was a trend ($p = .07$) for a main effect of Trauma factor scores, indicating that after collapsing across time points, women with more intrusive, avoidance, and dissociative symptoms were more likely to be smoking to a greater degree than were women with fewer of these symptoms ($Pr = .08$, small). However, the Trauma × Time interaction was not significant and its effect was minimal in size ($Pr = .04$) (Fig. 2).

Neither the main effect ($Pr = .04$) nor the interaction with Time ($Pr = .02$) was significant for the Self factor scores (Fig. 3).

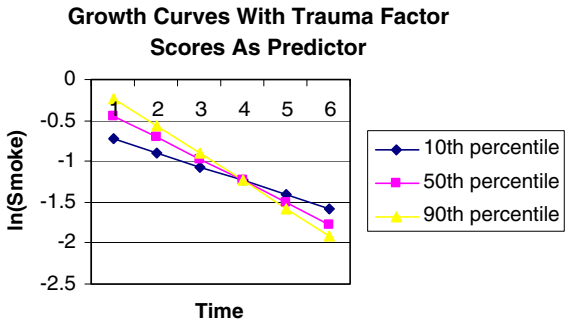

Fig. 2 Trauma factor scores as a predictor of smoking behavior over time

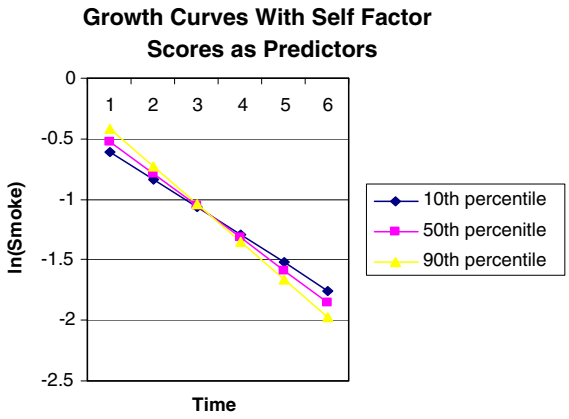

Fig. 3 Self factor scores as a predictor of smoking behavior over time

Discussion

This study examined the course of smoking over time in a sample of female veterans receiving treatment for trauma-related symptoms. Results suggested that across time points, more symptoms of negative affect (higher Dysphoria factor scores) were associated with higher rates of smoking. There was also a trend for trauma-specific symptoms (Trauma factor scores) such as intrusive experiences, avoidance, and dissociation to be associated with higher rates of smoking. These findings are consistent with previous cross-sectional research (e.g., Feldner et al. 2007a) demonstrating a relationship between trauma-related symptoms and smoking. A longitudinal relationship between smoking and trauma-related symptoms was observed only for negative affect (Dysphoria) with increases in negative affect symptoms associated with increases in smoking and decreases in symptoms associated with decreases in smoking. Additionally, this Time × Dysphoria factor interaction revealed that smoking decreased much more quickly among women with higher negative affect scores over time than among women with lower negative affect scores over time. All of these effects were small in size.

Because smoking has been identified as a strategy used by trauma victims to manage their often overwhelming affect (Feldner et al. 2007b), the observed pattern wherein decreases in negative affect symptoms were associated with decreases in smoking was not surprising. Although women in our sample were all enrolled in a clinic emphasizing the treatment of trauma, thus confounding treatment and the passage of time, it is interesting to consider the role that trauma-related treatment may have played in this pattern. For example, it is possible that treatment helped participants increase their repertoire and use of healthy coping strategies over time and in so doing, decrease their reliance on smoking as a tool for affect

management. This mediational relationship might explain why smoking decreased even in the absence of an explicit focus on smoking in treatment. However, it is unclear how this mechanism might relate to our findings that smoking decreased rapidly among women with higher Dysphoria scores over time but much more slowly among women with lower Dysphoria scores over time. That is, contrary to our initial study hypotheses, women with higher Dysphoria scores over time evidenced decreases in smoking even in the absence of decreases in symptomatology. One potential explanation is that perhaps women with lower negative affect scores had better developed and more varied coping skills from the start; women with higher negative affect scores had more room for improvement and thus showed greater decreases in smoking as they developed alternative coping strategies through participation in treatment. The fact that their symptomatology did not appear to decrease in the same sharp way as did their smoking may be related to the effect of treatment on other symptoms, such as substance use. For example, when smokers decrease their alcohol use, there seems to be a beneficial "carryover" effect to their smoking (Hintz and Mann 2007). Another explanation is that the finding could be an artifact of our measures, given that items asking about symptoms referenced the past 6 months whereas reports of smoking were more current.

Although the main effect of the Trauma factor suggests some link between smoking and intrusive experiences, avoidance, and dissociation, we did not find a relationship between smoking and these symptoms over time, as evidenced by the very small, nonsignificant Time × Trauma interaction effect. In addition, we did not find a significant relationship between impaired self-reference (Self factor scores) and smoking; the very small effect size observed for this analysis indicates that this null finding is not likely attributable to insufficient power. Given that the link between trauma, PTSD, and smoking is well-established, future research should focus on further exploring the association between specific trauma-related symptoms and smoking behavior. Future research would also benefit from exploring potential mediators of the relationship between trauma symptoms and smoking, such as coping style.

A number of limitations to the current study must be noted. First, our assessment of smoking behavior was based on only one variable that was not measured continuously and was not confirmed biochemically (e.g., cotinine measurement). Further, this variable assessed only current smoking at the time of assessment while our TSI items assessed symptoms for the entire intervening period since the previous assessment. Also, as is common in treatment occurring in a natural setting, treatment dosage and content varied individually. Additionally, although smoking cessation is not typically a focus of treatment within this clinic, we do not have data to address whether participants were actively trying to reduce their smoking, either within or outside the context of therapy. Finally, although we included only participants with complete, consecutive waves of data (i.e., those who had data for every time the questionnaire was administered during the course of their treatment), the total number of and length of time between assessments varied for many participants due to factors such as treatment completion and treatment drop-out. Specifically, after Time 1, our sample size dropped dramatically and several of our later follow-up points had data from only a few participants. HLM is able to handle this sort of unbalanced data, but our longitudinal findings in particular should still be considered preliminary and interpreted cautiously. Similarly, effect sizes should be prioritized over significance tests. That being said, many of the above limitations are a consequence of this study being conducted using a naturalistic dataset from a mental health clinic. Despite the limitations posed by research in a naturalistic setting and the recognized benefits of a more tightly controlled methodology, the uncontrolled nature of our dataset is also a strength in that it contributes to the ecological validity and real-world relevance of our findings.

Although our study represents a secondary data analysis on an existing dataset and was thus limited in the questions it could address, future studies would do well to explicitly test for mediators of the relationships we have identified here. Overall, our findings support previous research suggesting the existence of a relationship between smoking behavior and some trauma-related symptoms. Our findings further suggest that there may be a benefit of trauma-focused treatment for smoking even in the absence of an explicit focus on addiction. Given the numerous medical consequences associated with smoking (e.g., USDHHS 2004), harnessing this "side effect" by encouraging the development of healthier coping strategies to manage negative affect may be a powerful way to help improve both the physical and psychological well-being of trauma victims.

Acknowledgements This work was supported by a VA Rehabilitation and Research Development Career Development Award and resources were provided by the National Center for PTSD, Women's Health Sciences Division. The authors gratefully acknowledge the contributions of Erin Rowe, Jaimie Gradus, Eve Davison, Susan Doron-LaMarca, and Sheeva Mostoufi.

References

Acierno, R., Kilpatrick, D., Resnick, H. S., Saunders, B. E., & Best, C. L. (1996). Violent assault, posttraumatic stress disorder, and depression. *Behavior Modification, 20*, 363–384.

American Psychiatric Association. (2000). *The diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: American Psychiatric Association.

Beckham, J. C. (1999). Smoking and anxiety in combat veterans with chronic posttraumatic stress disorder: A review. *Journal of Psychoactive Drugs, 31*, 219–228.

Beckham, J. C., Lytle, B. L., Vrana, S. R., Hertzberg, M. A., Feldman, M. E., & Shipley, R. H. (1996). Smoking withdrawal symptoms in response to a trauma-related stressor among Vietnam combat veterans with posttraumatic stress disorder. *Addictive Behaviors, 22*, 93–101.

Breslau, N., Davis, G. C., & Schultz, L. R. (2003). Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Archives of General Psychiatry, 60*, 289–294.

Briere, J. (1995). *Trauma symptom inventory: Professional manual*. Odessa, FL: Psychological Assessment Resources.

Buckley, T., & Kaloupek, D. G. (2001). A meta-analytic examination of basal cardiovascular activity in posttraumatic stress disorder. *Psychosomatic Medicine, 63*, 585–594.

Center for Disease Control & Prevention. (2001). Cigarette smoking in 99 metropolitan areas—United States, 2000. *MMWM, 50*, 1107–1113. Retrieved January 8, 2001, from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5049a3.htm

Feldner, M. T., Babson, K. A., & Zvolensky, M. J. (2007a). Smoking, traumatic event exposure, and post-traumatic stress: A critical review of the empirical literature. *Clinical Psychology Review, 27*, 14–45.

Feldner, M. T., Babson, K. A., Zvolensky, M., Vujanovic, A. A., Lewis, S. F., Gibson, L. E., Monson, C. M., & Bernstein, A. (2007b). Posttraumatic stress symptoms and smoking to reduce negative affect: An investigation of trauma-exposed daily smokers. *Addictive Behaviors, 32*, 214–227.

Hapke, U., Schumann, A., Rumpf, H., John, U., Konerding, U., & Meyer, C. (2005). Association of smoking and nicotine dependence with trauma and posttraumatic stress disorder in a general population sample. *The Journal of Nervous and Mental Disease, 193*, 843–846.

Hintz, T., & Mann, K. (2007). Long term behavior in treated alcoholism: Evidence for beneficial carry-over effects of abstinence from smoking on alcohol use and vice versa. *Addictive Behaviors, 32*, 3093–3100.

Koenen K., Hitsman B., Lyons M. J., Niaura R., McCaffery J., Goldberg J. H., Eisen S. A., True W., & Tsuang, M. (2005). A twin registry study of the relationship between posttraumatic stress disorder and nicotine dependence in men. *Archives of General Psychiatry, 62*, 1258–1265.

McNally, R. J. (1989). Is anxiety sensitivity distinguishable from trait anxiety? Reply to Lilienfield, Jacob, and Turner (1989). *Journal of Abnormal Psychology, 98*, 193–194.

Ouimette, P. C., Brown, P. J., & Najavits, L. M. (1998). Course and treatment of patients with both substance use and posttraumatic stress disorders. *Addictive Behaviors, 23*, 785–795.

Ouimette, P., Coolhart, D., Funderburk, J. S., Wade, M., & Brown, P. J. H. (2007). Precipitants of first substance use in recently abstinent substance use disorder patients with PTSD. *Addictive Behaviors, 32*, 1719–1727.

Parslow, R. A., & Jorm, A. F. (2006). Tobacco use after experiencing a major natural disaster: Analysis of a longitudinal study of 2063 young adults. *Addiction, 101*, 1044–1050.

Raudenbush, S. W., Bryk, A. S., Cheong, Y. F., & Congdon, R. T. (2004). *HLM6: Hierarchical linear and nonlinear modeling*. Chicago: Scientific Software International.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis*. New York: Oxford University Press.

U.S. Department of Health and Human Services (2004). The health consequences of smoking: A report of the Surgeon General. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease and Prevention and Health Promotion, Office on Smoking and Health.

Zvolensky, M. J., Feldner, M. T., Leen-Feldner, E., Bonn-Miller, M. O., McLeish, A. C., & Gregor, K. (2004). Evaluating the role of anxiety sensitivity in smoking outcome expectancies among regular smokers. *Cognitive Therapy and Research, 28*, 473–486.